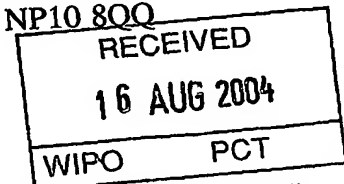


PCT/GB2004/003267



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
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I also certify that the application is now proceeding in the name as identified herein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

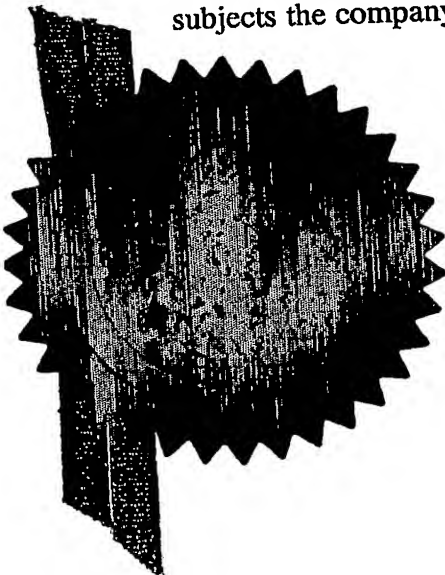
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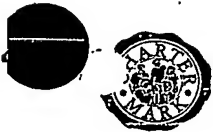
Signed

*H. Behen*

Dated

5 August 2004





GB 0317649.2

By virtue of a direction given under Section 30 of the Patents Act 1977, the application is proceeding in the name of:

ELECTROMAGNETIC GEOSERVICES AS,  
Stiklestadveien 1,  
7041 Trondheim,  
Norway

Incorporated in Norway,

[ADP No. 08898199001]

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP9 1RH

28 JUL 2003

1. Your reference DCR/P34241GB

2. Patent application number  
(The Patent Office will fill in this part)

0317649.2

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Statoil ASA  
Stavanger  
N-4035 Norway

SECTION 30 (1977 ACT) APPLICATION FILED

13/7/04

Patents ADP number (if you know it)

08204430001

If the applicant is a corporate body, give the country/state of its incorporation

Norway

4. Title of the invention

TRANSMITTER ANTENNA

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Kilburn & Strode  
20 Red Lion Street  
London  
WC1R 4PJ

Patents ADP number (if you know it)

125001 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

YES

**Patents Form 1/77**

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 5

Claim(s)

Abstract

Drawing(s) 2

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents  
(please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature

Date 28/07/03

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr. D.C. Rees  
Tel: 020 7539 4200

**Warning**

*After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.*

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- b) *Write your answers in capital letters using black ink or you may type them.*
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Transmitter Antenna

The present invention relates to a transmitter antenna for use in electromagnetic (EM) surveying beneath the ocean floor.

5

EM transmitter antennae are used to transmit low frequency ac current wave fields. The antennae may be deployed on an ocean floor but are generally towed behind a vessel as a cable or streamer.

10

It is an object of the present invention to provide a transmitter antenna which can be towed behind a vessel and which can provide a high current flow.

15

According to the present invention, there is provided an EM transmitter including a current source and a dipole antenna comprising a first electrode mounted on a cable and located near to the current source and a second electrode mounted on a cable and located further away from the current source, each electrode being electrically connected to the current source.

20

The electrodes may be mounted on the same cable but are preferably mounted on separate cables. The electrodes are preferably tubular or cylindrical and may be flush with the cable surface. They may be from 1 to 10m in length, preferably 4 to 8m eg. 6m. They preferably have a metal outer surface such as copper or aluminium or platinum-plated titanium. The advantage of Pt-plated Ti is that it will tend not to be degraded by sea water and so the electrical properties will be more stable over time.

25

The surface of the electrodes may be in the form of a grid and they may include buoyancy elements to render the electrodes neutral buoyant.

30

The electrodes are preferably spaced apart by a distance of between 100 and 1000m, more preferably between 200 and 500m, eg. about 250 to 300m.

The cable is sufficiently flexible to be wound on to and off a storage drum and slightly buoyant at towing depths down to 3500m. Slightly buoyant means the cable

can later be trimmed in the field by adding small weights. The antenna cables will be trailed behind a towed body containing the high current source. The cable preferably includes a power conductor, sensor wires and/or optical fibres for communications and an insulating outer sheath. There is preferably also a buoyancy material which  
5 may be in the form of a gel to allow for the required flexibility. The power conductor is also arranged to allow flexibility and is preferably in a braided annular form. The cable may comprise interconnected sections which may be 50 to 100m in length, preferably about 75m. Alternatively, the cable may be continuous. The overall diameter of the cable is about 80 to 200mm eg. about 120mm. The two antenna  
10 cables could be attached together alongside in a towing configuration by some sort of clip-on or sliding collars.

The cable is preferably capable of generating a voltage sufficient to provide a current of 100 to 10,000A, preferably 500 to 2000A, eg. about 1000A. The voltage may be  
15 from 75 to 500V, preferably from 100 to 200V eg. 120V. Typically a voltage of up to 120V generates an AC current of up to 1000A between the electrodes. The high current flow generates a low frequency electromagnetic field.

The cables may also include various sensors, such as depth transducers close to the  
20 two electrodes and one depth transducer and a temperatures sensor at the halfway point. The sensors may be positioned inside antenna cable and should be accessible for service in the field. An acoustic positioning transponder may be trailed from the antenna tail. The transponder can optionally be powered and triggered through the antenna cable. The sensors and command signals preferably communicate on an EM  
25 immune databus system.

In addition to being arranged two in line, the electrodes can be arranged in other configurations such as on the corners of a triangle or square.

30 The invention may be carried into practice in various ways and some embodiments will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic view of the transmitter antenna in use;

Figure 2 is a schematic view of a front electrode;

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Figure 3 is a schematic view of a rear electrode;

Figure 4 is a cutaway view of one embodiment of a cable;

10

Figure 5 is a cutaway view of a second embodiment of a cable.

Figure 1 shows an EM transmitter 11 in use at a depth of about 3500m below the ocean surface 12, just above the seabed 13. The transmitter 11 is towed by a surface vessel 14.

15

The transmitter 11 comprises a current source (not shown) located in a towing fish 15 connected to the vessel 14 by a line 16, and a dipole antenna 17. The antenna 17 comprises a front electrode 18 attached to the current source by a front cable 19 and a rear electrode 21 attached to the current source by a rear cable 22. The current source is capable of generating a voltage of 120V.

20

The front cable 19 is about 25 in length and is shown in more detail in Figure 2. The front electrode 18 is 6m long and is attached to the outside of the front cable 19. The rear cable 22 is about 300m in length and is shown in more detail in Figure 3. The rear electrode 21 is 6m long and is attached to the outside of the rear cable 22. The two cables 19, 22 and electrodes 18, 21 have neutral buoyancy.

25

Figure 2 shows the front cable 18 and front electrode 19. The front cable is about 25m in length and carries the front electrode 19 towards the rear end. The electrode 19 is about 6m long and made of a non-corrosive metal. The front cable 18 has a front depth sensor 23 at its rear end.

30

At its first end, the front cable 18 has a current connector 24 which is arranged to form a coupling with the current source in the fish 15 and a sensor connector 25 which forms a communications coupling with a control unit within the fish 15. The front depth sensor and any other sensors are connected to the sensor connector by means of a sensor conduit within the cable 18 as will be described in more detail below with reference to Figures 4 and 5.

At its rear end, the front cable 18 also has an electrode connector 26 which forms an electrical connection with the front electrode 19. The current connector 24 is connected to the electrode connector 26 by means of a conductor within the cable 18 as will be described in more detail below with reference to Figures 4 and 5.

The rear cable 22 and rear electrode 21 are similar to the front cable and electrode 19, 18, however, the rear electrode is about 300m long. At the front, the rear cable has a current connector 27 and a sensor connector 28; at the rear it has an electrode connector 29 and a tail depth sensor 31. In addition, it has a centre depth sensor 32 about half way along its length.

Both electrodes 18, 21 include buoyancy devices (not shown) to render them substantially neutrally buoyant.

Figure 4 shows the structure of the cable 41 used for the front and rear cables 19, 22, according to a first embodiment. The cable 41 comprises an outer insulating sheath 42, a conductor 43, an inner insulating sheath 44, a buoyancy gel 45 and a sensor conduit 46.

The outer sheath 42 is flexible, electrically insulating, water-impermeable and chemically stable in sea water. The conductor 43 is of braided copper wire and has a total transverse cross-sectional area of about  $250 \text{ mm}^2$ . The conductor 43 is connected at one end to the current connector 24, 27 and at its other end to the electrode connector 26, 29. In this way, the respective conductor passes current along its cable 19, 22 to the electrodes 18, 21.

The inner sheath 44 is flexible, water-impermeable and electrically insulating. The gel 45 is a buoyancy agent which is inherently flexible and is a known material in submarine cable technology. The sensor conduit 46 houses the necessary low power wires 47 and optical fibres 48 to establish communication between the various sensors such as the depth sensors 23, 31, 32 and the fish 15.

The second embodiment of cable 51 shown in Figure 5 is similar to the cable 41 in all respects except for the conductor 53. It comprises an outer sheath 52, a conductor 53, an inner sheath 54, a gel 55 and a sensor conduit 56 with wires 47 and optical fibres 48. However, in this embodiment, the conductor 53 is made up of tapes 59 of braided copper wire which are wound around the inner sheath 54. Again, the transverse cross-sectional area of the conductor 53 is about  $250\text{mm}^2$ .

1/

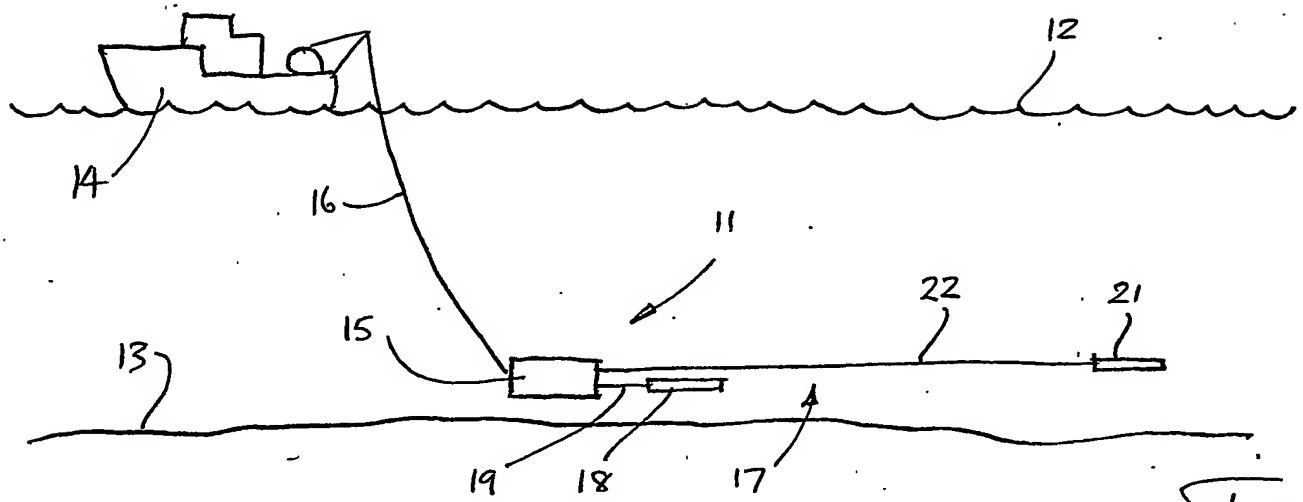


Fig 1

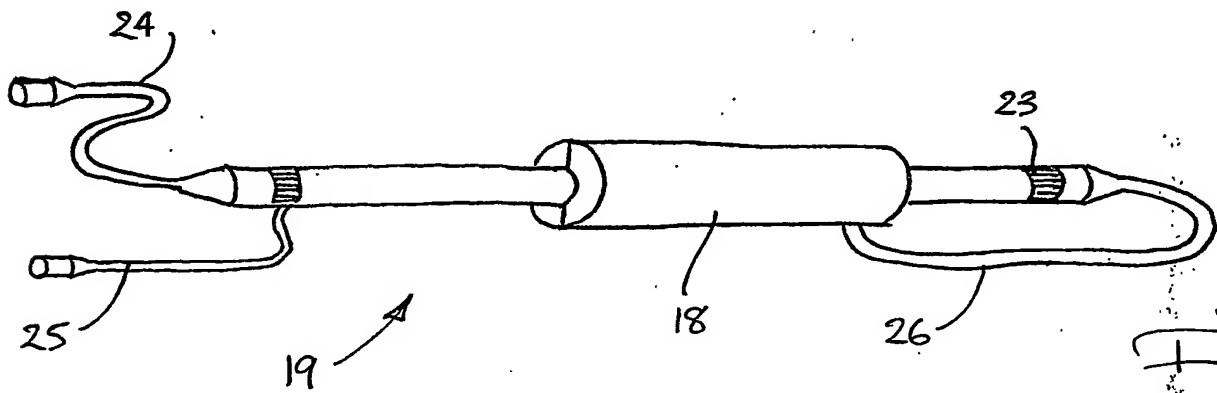


Fig 2

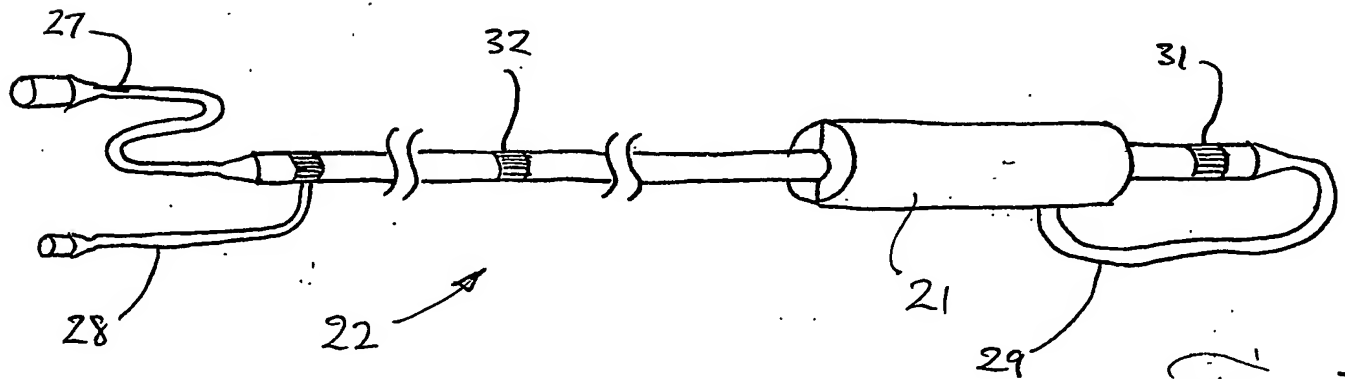


Fig 3

2/

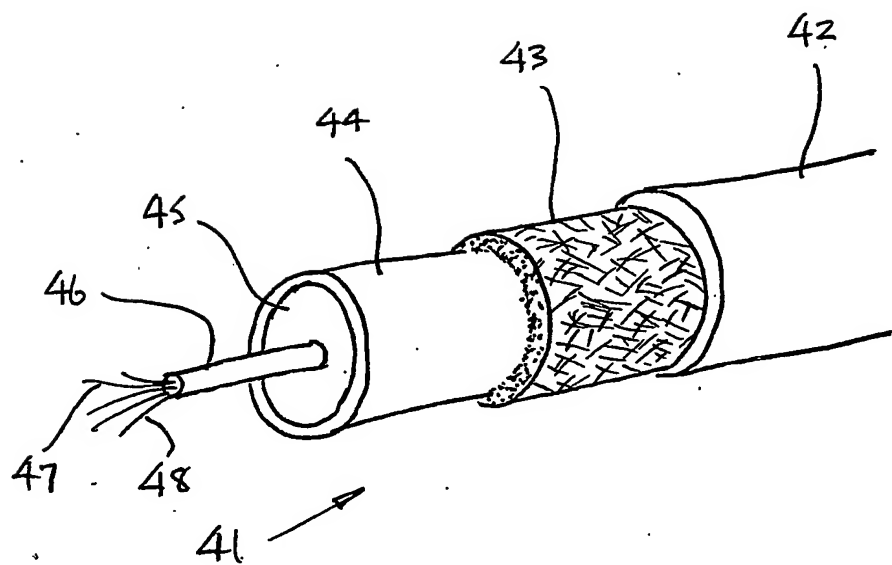


Fig 4

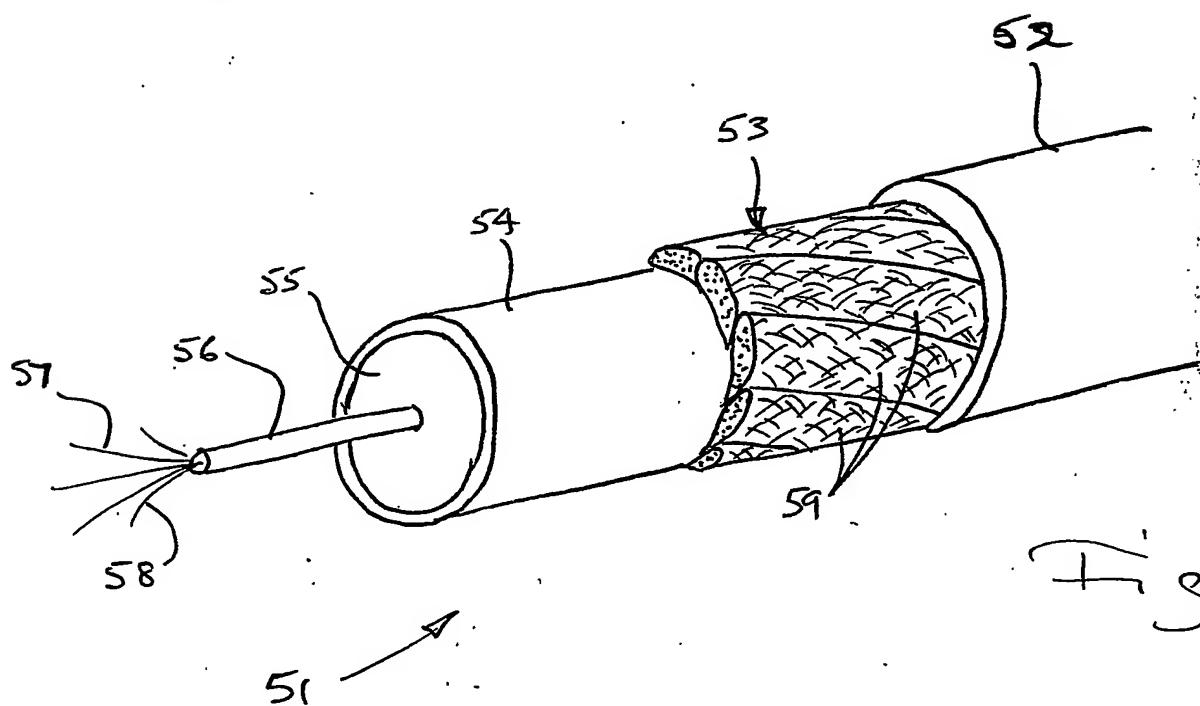


Fig 5